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(54) Remote control and pointing device.

(57) A control device method and apparatus has application for use in multi-media systems. The multi-media system contains a host computer having a video display, a control device and at least one target device. The target device is any remotely controlled equipment that the user wishes to integrate into the multi-media system. The host computer contains a host system configuration which provides the user the ability to select an operating mode for the control device. The control device operates as an interactive user interface to control a cursor on the host computer video display when the control device is placed in the cursor control mode. The user selects a remote control mode to remotely control the target devices using the control device. The host system configuration also includes learn and computer networking modes. In the learn mode, control data information is entered into the host system configuration for new target devices. In the computer networking mode, the control device operates as a network interface allowing other similarly equipped computers to communicate with the host computer.

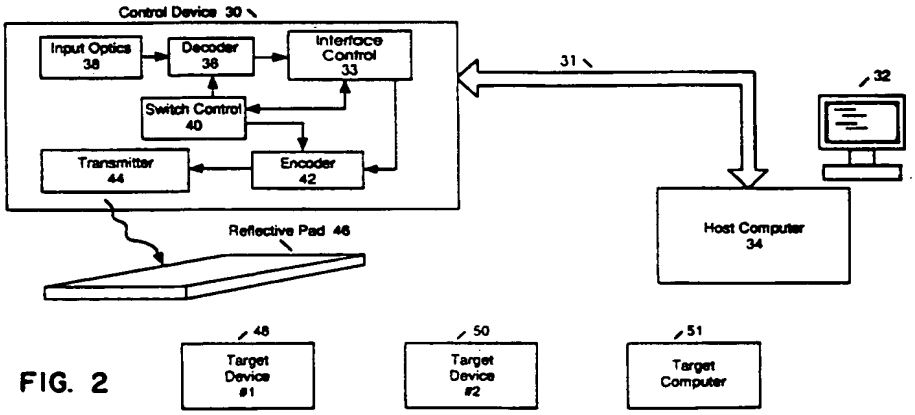

FIG. 2

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BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION:

The present invention relates to a control device, and more particularly, to an apparatus and method for communicating between a host computer system and at least one target system with a remote control system.

2. ART BACKGROUND:

A mouse, or a cursor control device, is an instrument that is used to translate the motion of a user's hand into a series of electrical control signals indicative of that hand movement. The mouse is coupled to a computer where the mouse generated control signals are used to position a cursor on a computer display. An optical mouse is a cursor control device that uses optical sensing to generate the electrical control signals. An advantage of the optical mouse over a traditional mechanical mouse is that the optical mouse does not employ any moving parts to generate the control signals. The optical mouse emanates an optical signal, usually in the infrared range, generated from a light emitting diode (LED). To generate the control signals, the mouse is moved on a reflective pad having a large number of equally spaced vertical and horizontal lines. The vertical and horizontal lines have a different color than the background of the reflective pad. The optical mouse is placed on the reflective pad such that the optical light from the LED is reflected from the pad back into the optical mouse.

The optical mouse further includes input optics and optical sensors mounted on the bottom of the mouse. The optical sensors generate an electrical signal proportional to the light incident upon the optical sensor. The LED and the optical sensors are arranged such that the light emanating from the LED is reflected off the pad and onto the optical sensors. To operate the mouse, a user moves the optical mouse across the reflective pad such that the optical light crosses over the horizontal and vertical lines. The amount of light reflected is decreased when the light crosses over one of the horizontal or vertical lines on the pad. Consequently, the light incident upon the photo diodes is decreased, and the mouse is able to detect the crossing of the line. The optical mouse generates four quadrature signals to indicate the movement to the computer based on the mouse crossing the horizontal and vertical lines. Typically, these four parallel quadrature signals are coupled to a standard serial interface such as a universal asynchronous receiver transmitter (UART). The UART converts the quadrature signals into an encoded stream of serial data for transmission to the host computer system.

Applications in optical transmissions are also found in consumer electronic devices. Consumer electronics devices, such as televisions and video cassette recorders (VCRs), often include remote control systems. Manual control systems, unlike remote control systems, require the user of the electronic device to physically go to the device to manipulate knobs and buttons. With the use of remote control, the user can control the device, from a limited distance, with a remote control unit thereby eliminating the need to physically touch the controls and adjustments on the device itself. The basic remote control system contains a transmitter on the remote control unit and a receiver on the device. The remote control unit contains buttons where each button correlates to a device function. Each function is represented by an unique function code having a string of logical ones and zeros. When the user presses a button on the remote control unit for a desired function, the remote control unit retrieves the corresponding function code and transmits it to the device. Various manufacturers of remote control systems use both different function codes and encoding techniques to modulate the function codes. The device receives the modulated function code, demodulates the code back into a string of ones and zeros, and performs the desired function.

Multi-media is the integration of several audio and video production units into a single controllable unit. Multi-media projects cover many communication media types, including printed materials, audio programs, television shows, feature films and many others. The ability to integrate the functions of the resources utilized in the production of multi-media projects into a single shared system provides a level of performance and capability unknown in the prior art. A computer workstation may be the center of such a system by providing memory and digital processing capabilities. Referring to **FIGURE 1**, a multi-media system is illustrated. A central control computer **20** is networked to: television **22**; video cassette recorder (VCR) **24**; video laser disc **26**; and compact audio disc **26**. With such an integrated system, the user, at central control computer **20**, can transfer information among the devices attached to the integrated network.

A multi-media system, such as the one illustrated in **FIGURE 1**, provides the user with a very powerful audio visual production center. For example, the user may wish to manipulate a video image stored on laser disc **26**. First, the video image must be transferred over the network from laser disc **26** and stored in memory in central control computer **20**. To accomplish this task, the user would command, by a remote control unit,

laser disc **26** to play the video image over the network. Alter the video image is transferred to central control computer **20**, the user may add special effects to the video image creating these effects directly on the computer. Alter generating the enhanced video image, the user may wish to store the video image on VCR **24**. To accomplish this task, central control computer **20** sends the video image via some kind of interconnect (often in analog video), and the user remotely controls VCR **24** to record the enhanced video image. In this example, in order to control both laser disc **26** and VCR **24**, the user is required to use two remote control devices. Furthermore, the user is required to use a computer interactive device such as a mouse.

SUMMARY OF THE INVENTION

Therefore, it is an objective of the present invention to integrate a control device such that the control device may operate both as a cursor control device and a remote control deuce. It is a further objective of the present invention to provide a network interface among similarly equipped computer systems having a control device of the present invention.

The present invention comprises of a host computer having a video display, a control device including a reflective pad and at least one target device. The target devices are remotely controlled audio and video equipment. The control device is coupled to the host computer through an interface. A host system configuration resides on the host computer allowing the user to control the operation of the control device by selecting a mode. The host system configuration includes a target device list which contains identifying names for the target devices currently supported by the host computer. For each target device on the target device list, there is a corresponding function list. The function list contains control data for each function of the target device supported by the host system configuration. If no mode is selected, the control device operates in a cursor control mode. From the host system configuration, the user may select a remote control, learn or computer networking modes.

The control device has an encoder coupled to a transmitter, and a decoder coupled to input optics. When the control device is operating in the cursor control mode, the user moves the control device across the reflective pad to control the movement of a cursor on the host computer video display. The transmitter of the control device emanates a signal, preferably in the optical range, which is reflected off the reflective pad and into the input optics. The input optics amplifies the reflected signal for input to the decoder. The decoder generates position signals based on the intensity of the reflected signal. When the control device is in the remote control mode, the host computer sends target device control data over the interface to the encoder. The encoder generates an analog signal from the control data, and modulates the transmitter with the analog signal. To control the target device, the user holds the control device such that the bottom of the device is pointed at the target device. Upon depressing a switch on the control device, the control device transmits the modulated signal to the target device.

The learn mode of the present invention allows the host system configuration to "learn" control data for functions of a target device. In the learn mode, new target devices are added to the target device list. In addition, control data is added to the function list for the corresponding target device. The control device also operates as a computer network interface when the user selects the computer networking mode from the host system configuration. In the computer networking mode, the host computer sends information, modulated by the encoder in the control device, to target computers equipped with the control device of the present invention. The target computer sends modulated messages to the host computer which are decoded in the control device and subsequently transferred to the host computer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 illustrates a multi-media system including a central control computer.

FIGURE 2 is an illustration of the control device of the present invention.

FIGURE 3 is an illustration of the host system configuration of the present invention.

FIGURE 4 is a flow control diagram of the remote control mode of the present invention.

FIGURE 5 is a flow control diagram of the learn mode of the present invention.

FIGURE 6 is a flow control diagram of the computer network mode of the present invention.

FIGURE 7 is a block diagram illustrating the control device decoder of the present invention.

FIGURE 8 is a block diagram illustrating the control device encoder of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A method and apparatus for a control device is disclosed. In the following description, for purposes of explanation, specific nomenclature is set forth to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that these specific details are not

required to practice the present invention. In other instances, well known circuits and devices are shown in block diagram form to avoid obscuring the present invention unnecessarily.

Referring to **FIGURE 2**, a high level block diagram of the present invention is illustrated. Host computer **34** is coupled to control device **30** through interface **31**. The host computer **34** may be a computer system such as a SPARC™ workstation, manufactured by Sun Microsystems, Inc. of Mountain View, California. Interface **31** is bi-directional such that host computer **34** transmits information to control device **30**, and control device **30** transmits information to host computer **34**. Control device **30** inputs external signals through input optics **38**, and the external signals are interpreted by decoder **36**. Information generated by decoder **36** is transferred to interface control **33**, and then transmitted through interface **31** to host computer **34**. Information transmitted from host computer **34** over interface **31** is received by control device **30** at interface control **33**. The information is then transferred to encoder **42** and subsequently transmitted by transmitter **44**.

Host computer **34** provides a user the ability to select among a plurality of operating modes for control device **30**. These operating modes include a cursor control mode, a remote control mode, a learn mode and a computer networking mode. If no mode is selected by the user, control device **30** operates in the cursor control mode. In the cursor control mode, control device **30** will be placed on top of reflective pad **46**. When the user selects either the remote control or the learn mode, control device **30** will operate as a remote control device. When used as a remote control device, the bottom of control device **30** is directed at a target device, such as target device **48** or **50**. Also, when the user selects the computer networking mode from host computer **34**, control device **30** operates as a network interface. In the computer networking mode, the bottom of control device **30** is directed at a target computer such as target computer **51**.

In the cursor control mode, control device **30** is a cursor control device. As a cursor control device, position data is generated by decoder **36** based on the movement of control device **30** on reflective pad **46**. Position data are transferred from decoder **36** to interface control **33** and then transmitted over interface **31** to host computer **34**. In the cursor control mode, datum is not transferred from the host computer **34** to control device **30**. Because of this, encoder **42** of control device **30** is bypassed such that transmitter **44** will provide a continuous signal output to reflective pad **46**. The continuous output signal is reflected by reflective pad **46** back toward control device **30**. The reflected signal is collimated and amplified by input optics **38** and projected upon photosensitive cells in decoder **36**. Because the system is in cursor control device mode, decoder **36** is selected to decode the illumination of the photosensitive cells to generate position data. The position data are then transferred to the host computer **34** to control a cursor on video output display **32**.

To select a particular mode for control device **30**, the user, though a man to machine interface on host computer **34**, activates a mode selection menu. Because a mode has not been selected, control device **30** will automatically operate in the cursor control mode. The mode selection menu may be displayed and accessed by the user by any type of man to machine interface. Preferably, a graphical user interface is used, and control device **30** modes are viewed by user as icons. Regardless of how the man to machine interface is accomplished, host computer **34** will display the mode selection to the user on video output display **32**. The user may use a keyboard, or control device **30** as a cursor control device, to select the desired operating mode for control device **30**. Once a mode has been selected, another menu will appear prompting the user to make more selections for the desired function as will be more fully explained below.

Referring to **FIGURE 3**, the host system configuration of the present invention is illustrated. In order to support the remote control, learn, and computer networking modes, host computer **34** must contain specific information about target devices and target computers. User interface **54** is the man to machine interface between the host system configuration and the user. Any user interface may be employed to implement the structure of the host system configuration. Mode selection module **56** illustrates the first level of the host system configuration. As described above, mode selection module **56** provides a menu from which the learn, remote control, and computer networking modes are selected. To support the selection of remote control mode, remote control mode module **62** accesses target device list **64**. Target device list **64** comprises a list of all the target devices currently supported by the host system configuration. For each target device in target device list **64**, there is a corresponding function list illustrated as function list **66**. As illustrated in **FIGURE 3**, a target device may only access the corresponding target device function list that corresponds to that target device. Function list **66** stores control data for each of the target device functions listed in function list **66**. For example, for target device **#1**, there is a target device **#1** function list which stores the control data for all of the currently supported target device **#1** functions.

Still referring to **FIGURE 3**, learn mode module **60** is selected from mode selection module **56**. Learn mode module **60** provides the user the ability to edit target device list **64** and function list **66**. If the user wishes to add another target device to the host system configuration, then target device edit module **68** allows the user to enter an identifying name for the new target device. Once target device list **64** has been edited to contain the new target device, function list edit module **70** allows the user to add target device functions to function list **66**. In the learn mode, control data will be entered into function list **66** under the corresponding function. When control device **30** is in the computer networking mode, computer mode module **59** is selected by mode selection **56**. Computer mode module **59** contains network computer list **72**, network computer address list **74** and network computer edit **76**. The user has the ability to select a target computer from network computer list **72**. If the desired target computer is not listed on network computer list **72**, then network computer edit module **76** is activated which allows the user to add an identifying name for the new target computer. Similarly, network computer addresses are added by the user for the newly added target computer through computer network edit **76**.

Referring to **FIGURE 4**, a flow diagram of the remote control mode is illustrated. In the remote control mode, control device **30** operates as a remote control device which controls virtually any product utilizing a remote control system. Alter the user has selected the remote control mode through mode selection module **56**, host computer **34** displays a list of the available target systems as shown in block **78**. In block **80**, the user is prompted to select a target device. For example, the user may select a first VCR which is identified on the target device list as "VCR **#1**". Upon selection of the desired target device, the host computer **34** displays a function list for the particular target device selected as illustrated in block **82**. Next, host computer **34** will prompt the user to select a desired function from the function list as shown in block **84**. For example, if "VCR **#1**" is chosen as the target device, the function list will display all functions for "VCR **#1**" residing in the function list. The function list for "VCR **#1**" may contain "Power", "Play", "Rewind", "Fast Forward" and "Record".

Upon completion of selecting the desired function by the user, host computer **34** retrieves the control data stored in the function list for the corresponding selected target device as shown in block **86**. In block **87**, host computer **34** transmits a message through interface **31** which enables switch control **40**. Then, in block **88**, the user points the bottom end of control device **30** at the target device. In block **90**, the user depresses a switch located on control device **30** which converts control device **30** from a cursor control device to a remote control device. The depressing of the switch initiates the transmission of the control data from host computer **34** to control device **30** as illustrated in block **92**. In block **94**, control device **30** reconstructs the control data in the original analog format, and transmits the control data to the target device. Alter the control data has been transmitted, the host computer **34** places control device **30** in the cursor control mode as shown in block **95**. The user now has full use of control device **30** as an interactive cursor control device. In block **96**, host computer **34** queries the user about whether to remain in the remote control mode. If the user wishes to remain in the remote control mode, host computer **34** will prompt the user as to whether a new device is desired, as illustrated in block **97**. If the user does wish to execute another function for the target device selected, then host computer **34** will display the target device list. Alternatively, host computer **34** will display the target system as shown in block **78**, and the user may then select a new target device.

Referring now to **FIGURE 5**, a flow diagram of the learn mode of the present invention is illustrated. Learn mode allows the user to add both new target device systems functions to the host system configuration. In this way, any target device using a remote control unit in the same optical band as control device **30** can be "learned" by host computer **34**. Even if the format for the control data of the desired target system's remote control is completely different than any other target device, host computer **34** can still learn the sequence for the control data. To enter learn mode, the user selects the mode selection menu. Within the mode selection menu, the user selects the learn mode option as indicated in block **98**. The user determines whether a desired target device exists in the host system configuration by viewing the target device list. If the desired target device is not on the target device list, the user is prompted to enter an identifying name of the new target device as shown in block **104**. The name is a mere identifier, and the target device name can be any name the user wishes to associate with the new target device. For example, if the user has a second VCR in which the user desired to integrate into a multi-media system, the second VCR could be named "VCR **#2**". After the user has entered the name of the net target device, host computer **34** adds the new target device to the target device list as well as to the corresponding function list as illustrated in block **106**. Next, the user adds functions associated with the new target device such that the control data of the associated functions will be learned by

host computer **34**.

The procedure for learning functions for a new target device is illustrated at block **108** in the flow diagram of **FIGURE 5**. First, the user is prompted to enter an identifying name of the function. Host computer **34** adds the function name to the function list under the newly created designation for the new target device. At this point, the host system configuration is ready to accept control data. In block **109**, host computer **34**, through interface **31**, enables switch control **40**. In block **110**, the user points the bottom of control device **30** at the remote control unit for the new target device. In block **112**, the user depresses a switch on the control device **30** which places the control device **30** into remote control mode. Next, the user depresses the desired function key on the target device remote control unit as illustrated in block **116**. Upon depressing the function key on the target device remote control unit, the control data for the function is transmitted to control device **30**. In control device **30**, the control data is received and demodulated, and then transferred to the host computer **34**. In block **118**, host computer **34** determines whether the transmission is the first or second transmission of the function. In it is the first transmission, then the data is stored in a comparison buffer in host computer system **34**.

Upon receipt of the first transmission of the control data for the function by host computer **34**, host computer **34** prompts the user to repeat the transmission of the control data from the target device remote control unit to the control device **30** as illustrated in block **110**. The user executes the procedure of blocks **110**, **112** and **116**, whereby a second transmission of control data is performed. In block **119**, host computer **34** compares the second transmission of the control data to the first transmission of the control data to ascertain any differences. If the control data sequences are the same, the control data is stored in the host system configuration. If the comparison yields that the sequences are not the same, then both transmissions are repeated starting in block **110**. The purpose of transmitting the control data twice is to ensure the proper control data is associated with the desired function. The two transmissions reduce the possibility that an error has occurred, and provide control data integrity for the function. In block **120**, host computer **34** places control device **30** into cursor control mode. If the user wishes to remain in the learn mode, then the user is prompted by host computer **34** to select a target device system.

Referring to **FIGURE 6**, a flow diagram of the computer networking mode of the present invention is illustrated. After the user has selected the computer networking mode through mode selection module **56**, host computer **34** displays the network computer list **72** as shown in block **122**. Network computer list **72** contains all the target computers currently supported in the host system configuration. Then, the user ascertains whether the target computer resides on the network computer list **72**. If it does not, then the user executes block **126** by entering an identifying name for the new computer to be added to the network computer list **72**. In addition to entering a name for the new target computer, the user also enters the target computer address for the network computer address list. Additional hardware could be added to host computer **34** and the target computers to perform higher level networking functions such as address recognition. However, it is currently recognized by practitioners in the art of computer networking, that tradeoffs between implementing certain features directly in electronic circuits or implementing these features in software does not materially change the fundamental nature of the implementation. In order to improve the communication bandwidth and to reduce the likelihood of accidentally issuing a command to a target device, instead of a target computer, a different encoding method may be employed. For example, a different frequency and duration for encoding a logical one state can be employed. In this way, other target computers can ascertain whether another computer is currently transmitting.

When a user desires to transmit a message on the computer network, the user must first select a target computer from the network computer list as illustrated in block **130** of **FIGURE 6**. After the user selects a message to transmit to the target computer, host computer **34** obtains the address for the target computer from the network computer address list as shown in blocks **132** and **134**, respectively. In block **136**, host computer **34** merges the address information for the selected target computer with the message selected. Then, in block **137**, host computer **34** enables switch control **40**. To transmit the message to the target computer, the user points the bottom of control device **30** at the target computer and depresses switch **41** on the control device **30** as shown in blocks **138** and **140**. Upon depression of switch **41**, host computer **34** transfers the message from host computer **34** to control device **30** as illustrated in block **142**. In block **144**, control device **30** reconstructs the control data into an analog modulated wave form for transmission to the target computer. Upon transmission of the message, host computer **34** places control device **30** into the cursor control mode as illustrated in block **145**.

Referring now to **FIGURE 7**, a block diagram of decoder **36**, input optics **38**, interface control **33** and switch control **40** are illustrated. Input optics **38** receives external signals from reflective pad **46**, a

target computer or a remote control unit. Preferably, input optics **38** contains an aperture at the bottom of control device **30** which allows the external signal, such as an infrared signal, to pass into input optics **38**. Input optics **38** also contains an optical guide and lens. The external signal passes through the aperture and is amplified and focused by the lens. The external signal is then collimated through the optical guide, and focused upon sensor array **148**. The focal distance between the lens and sensor array **148** is a predetermined value. Sensor array **148** may be a single photosensitive cell or an array of photosensitive cells. Photosensitive cells generate an electrical signal proportionate to light intensity incident upon the cell. The photosensitive cells may be photo diodes or any other form of photo voltaic cells. For example, sensor array **148** could be arranged in a 2x2 array of photosensitive cells, or it may be arranged in a linear array comprised of **4** photosensitive cells.

The output of the sensor array **148** is connected in parallel to both the imager **152** and an A to D converter **160**. The signal on control line **151** is generated by switch control **40**. Switch control **40** contains switch **41**, AND gate **165** and D type flip-flop **163**. Switch **41** is a momentary micro switch which is accessible to the user at the top of control device **30**. The output of switch **41** is coupled to the D and dock inputs of flip-flop **163**, preferably through a debouncing circuit (not shown). Flip-flop **163** is reset by mode select **161** such that a falling edge of a high to low signal transition on mode select line **161** initials flip-flop **163** to a low logic state. AND gate **165** has two inputs; a first input coupled to the Q output of flip-flop **163** and a second input coupled to mode select **161**.

Initially, the Q output of flip-flop **163** retains a low logic state. After the user has selected, for example, the learn mode in the host system configuration, host computer **34** sets, through interface control **33**, mode select line **161** to a high logic state. At this time, the user depresses switch **41** causing the Q output of flip-flop **163** to toggle to a high logic state. With both mode select **161** and Q output of flip-flop **163** at a high logic state, the output of AND gate **165**, which drives control line **151**, is set to a high logic state. A high logic state on control line **151** will cause MUX's **172** and **149** to operate in the learn, computer networking, or remote control modes and selects whether the A to D **160** or the imager **152** is active. To convert control device **30** back to the cursor control mode, host computer **34** places mode select **161** in a low logic state, and the falling edge of a high to low signal transition of mode select line **161** resets flip-flop **163** to a low logic state. A low logic state on mode select **161** and an initialized flip-flop **163** pull control line **151** to a low logic state. A low logic state on control line **151** selects the cursor control mode at MUX's **149** and **172**.

When control device **30** is in the cursor control mode, decoder **36** generates position data. As described above, control line **151** actuates the imager **152** such that electrical charges generated by sensor array **148** are processed by bit map imager **152**. Bit map imager **152** generates a bit map based on the illumination of photosensitive cells in sensor array **148**. Preferably, bit map imager **152** consists of cell inhibition logic and timing logic. The cell inhibition logic is coupled to sensor array **148** such that the first cell to obtain a predetermined threshold charge will inhibit other neighboring cells. The inhibition of neighboring cells results in the generation of bit map images. For example, sensor array **148** may contain a 2x1 photosensitive cell array consisting of two linear cells for horizontal movement detection. Applying a cell inhibition technique to the array, one cell will be inhibited when the other cell is illuminated to the predetermined threshold value. In this example, there is a possibility of three bit map images; a first bit map image consists of illumination of the first cell only; a second bit map image consists of illumination of the second cell only; and a third bit map image consists of no cells illuminated. As control device **30** is moved across the horizontal lines of the pad, the photosensitive cell receiving light reflected from the background will illuminate the photosensitive cell to the threshold value faster than the other photosensitive cell receiving light reflected from a horizontal line. A linear 2x1 vertical array senses the movement in a vertical direction in a similar manner. Based on this technique, other more complex arrays, such as a 4x4 photosensitive cell array, could be implemented. Larger arrays provide greater position resolution for cursor control on a video output display.

Once a first bit map image is generated, bit map imager **152** generates signals to dear sensor array **148**. Because control device **30** is operating in the cursor control mode, control line **151** selects bit map imager **152** in MUX **149** to control the initialization input to sensor array **148**. Bit map imager **152** is self timed because a bit map image will be generated when one or more of the photosensitive cells are illuminated to the threshold value. The first bit map image is transferred to coordinate generator **154** while a second bit map image is being generated in sensor array **148**. Preferably, coordinate generator **154** contains comparison means, a look-up table and a quadrature signal generator. The first bit map image is stored in a comparison buffer. The second bit map image is generated from bit map imager **152**, and then transferred to a second comparison buffer in co-

ordinate generation **154**. Upon receipt of the second bit map image, coordinate generation **154** compares the first bit map image with the second bit map image. The comparison yields a look-up code; the look-up code indicating differences between the first bit map image and the second bit map image.

The look-up code generated from the comparator means is used to index the look-up table. The look-up table generates a control code indicating the direction and distance of the movement of the control device. For example, in the 2x1 horizontal cell array described above, if the first bit map image contained a {1, 0} illumination, and the second bit map image contained a {0, 1} illumination, then the bit map image would generate a control code indicative of a horizontal move to the right. The control code from the look-up table must be converted into the well known quadrature signal format for cursor control devices. The control code is input to the quadrature signal generator, and the quadrature signal generator generates the four quadrature signals. The quadrature signals are input to transceiver **146**, and then transferred to host computer **34**.

A block diagram of demodulator **158** is illustrated in **FIGURE 7**. As discussed above, the output of sensor array **148** is an analog signal proportional to the light intensity incident upon the photosensitive cells of sensor array **148**. In the learn mode, the analog signal is the modulated control data from the remote control unit. In the computer networking mode, the analog signal is the modulated message from a target computer. The analog signal is input to demodulator **158** in analog to digital (A/D) converter **160**. Methods for A/D conversion are well known in the art, and A/D converter **160** may employ a flash method, a half flash method, or any other method of analog to digital conversion. The initialization of sensor array **148** is controlled by the output signal of MUX **149**. In the computer networking or learn modes, control line **151** selects dock **156**. In operation, the photosensitive cells of sensor array **148** are illuminated during a first phase of the clock **156** cycle. During the second phase of the dock cycle, A/D converter **160** reads illuminated cell values, and clock **156** clears the photosensitive cells in sensor array **148**.

In the preferred embodiment, the sampling frequency of dock **156** is 500 Khz. Typically, a remote control unit modulates each bit of control data in 600 microsecond pulses. A logical one bit of control data is represented by a 50 Khz tone modulated on the 600 microsecond pulse, and a logical zero bit is represented by no tone modulated on the 600 microsecond pulse. For this control data modulation scheme, A/D converter **160** samples the analog input signal five times the highest input frequency. Therefore, at a sampling frequency five times the input frequency of the analog signal, demodulator **158** generates a digital signal which accurately represents the input analog signal. Using A/D conversion, the operation of control device **30** is not dependent upon the format of the input control data signal.

The digital output of A/D converter **160** is input to filter **162**. Preferably, filter **162** is an anti-alaising filter that filters out the sampling harmonics generated by the sampling of A/D converter **160**. The bandwidth characteristics of filter **162** are determined by the sampling frequency of dock **156**, and if the input analog signal is sufficiently over sampled, a wide bandwidth for filter **162** does not degrade system performance. The output of demodulator **158** is input to channel B of transceiver **146**. In the preferred embodiment, transceiver **146** is a universal asynchronous receiver transmitter (UART) which is a standard interface between a cursor control device and a host computer. Control line **151** is connected to channel select on transceiver **146**. The selecting of channel A or channel B of transceiver **146** is determined by the logic state of control line **151**. A logic low state on control line **151**, designating control device **30** is in the cursor control mode, selects channel A. Alternatively, a logic high state on control line **151** selects channel B when control device **30** is in the learn, remote control or the computer networking modes.

Referring to **FIGURE 8**, encoder **42**, transceiver **164** and transmitter **44** are illustrated. Control data transferred from host computer **34** is received by control device **30** at transceiver **164**. Control data are input to encoder **42**, and encoder **42** generates a modulated signal. The output of encoder **42** is a first input to MUX **172**, and a second input to MUX **172** is coupled to a power source for control device **30**. The output of MUX **172** is coupled to transmitter **44**. When control device **30** is in the cursor control mode, control line **151** selects the power source input to transmitter **44**. In the preferred embodiment, transmitter **44** is an infrared light emitting diode (LED). Therefore, in the cursor control mode, the LED is supplied a constant power source, and the output of transmitter **44** will not be modulated. Alternatively, when control line **151** selects the encoder **42** output, the modulated signal generated by encoder **42** is transmitted by the LED.

The input to encoder **42** is the control data, in digitized form, transmitted from host computer **34**. Transceiver **164** will receive control data at a serial bit rate corresponding to the data transferred from host computer **34** to transceiver **164**. Encoder **42** contains buffer **166**, digital to analog converter (DAC) **168** and filter **170**. Control data is transferred

om transceiver **164** to buffer **166** in encoder **42**. Buffer **166** stores a plurality of control data entries allowing encoder **42** to receive the control data at a data rate driven by transceiver **164**. Buffer **166** is coupled to DAC **168** by data lines **165** and enable line **167**. Buffer **166** generates a signal over enable line **167** signifying control data has been received by buffer **166**. Once DAC **168** is enabled by enable line **167**, DAC **168** begins to clock in control data stored in buffer **166** at the clocking rate of clock **156**. Control data is converted in DAC **168** from digital data to an analog signal. In the remote control mode, the analog signal is a reconstruction of the analog signal received by control device **30** in the learn mode. In the computer networking mode, the analog signal is a modulated message transferred from host computer **34**. The analog output of DAC **168** is input to filter **170**. Filter **170** reduces or eliminates frequencies generated in the digital to analog process of DAC **168**. Filter **170** has a sufficient bandwidth to accommodate the reconstruction of a wide range of control data.

While the present invention has been described in terms of a presently preferred embodiment, those skilled in the art will recognize that the invention is not limited to the embodiment described. The method and apparatus of the present invention can be practiced with modification and alteration within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of restrictive on the present invention.

Claims

1. In a system having a host computer and at least one target device wherein said host computer comprises of a central processing unit (CPU), memory for storing a plurality of control functions, a video output display, a control device for generating position data relative to movement of said control device for display on said video output display and for remotely controlling said target device currently supported by said host computer, said control device comprising:

   host system configuration means for generating a plurality of operating modes on said host computer to be selected by said control device and for generating control data to operate said target device, said control data corresponding to one of said plurality of operating modes selected;

   cursor control means coupled to said host system configuration means for generating position data to said video output display, said cursor control means being capable of selecting one of said plurality of operating modes from said host system configuration means by controlling said video output display through said position data;

   receiver means coupled to said cursor control means for receiving said control data from said host system configuration means;

   encoder means coupled to said receiver means for modulating said control data corresponding to said one selected mode to generate modulated control data;

   transmitter means coupled to said encoder means for transmitting said modulated control data representative of said one selected mode to said target device.

2. A control device according to claim **1**, wherein said cursor control means comprises:

   position means for generating displacement signals representing the movement of said cursor control means relative to said position means, said cursor control means emitting a continuous signal during the movement; and

   decoder means coupled to said cursor control means for generating said position data to said video output display responsive to said displacement signals.

3. A control device according to claim **1**, wherein said host system configuration generates said plurality of operating modes to be selected through a graphical user interface menu displayed on said video output display, one of said plurality of operating modes being selected by said position data.

4. A control device according to claim **3**, wherein said host system configuration means comprises:

   remote control means for retrieving remote control functions stored in said memory of said host computer system when selected as one of said plurality of operating modes and transferring said remote control functions to said target device through said encoder means and said transmitter means;

   learn control means for updating said memory of said host computer system with the control functions associated with a second target device not previously coupled to said system when selected as one of said plurality of operating modes, said control functions associated with said second target device being subsequently invoked by said remote control means;

   cursor mode means for activating said cursor control means when selected as one of said plurality of operating modes.

5. A control device according to claim 4, said host system configuration means further comprising:

network control means for retrieving network control functions store in said memory of said host computer system when selected as one of said plurality of operating modes and when said system is coupled to a third target computer through a network, said network control means transferring said network control functions to said target device through said encoder means and said transmitter means.

6. A control device according to claim 5, wherein transmitter means transmits said modulated control data in infrared signal.

7. A control device according to claim 2, wherein said position means generates said displacement signals by reflecting said continuous signal from said cursor control means and said decoder means comprises an optical input for receiving the reflected continuous signal.

8. In a system having a host computer and at least one target device wherein said host computer comprises of a central processing unit (CPU), memory for storing a plurality of control functions, a video output display, a method of generating position data relative to movement of said control device for display on said video output display and of remotely controlling said target device currently supported by said host computer, said method comprising the steps of:

generating a plurality of operating modes on said host computer on host system configuration means to be selected by said control device and for generating control data to operate said target device, said control data corresponding to one of said plurality of operating modes selected;

generating position data to said video output display through cursor control means coupled to said host system configuration means, said cursor control means being capable of selecting one of said plurality of operating modes from said host system configuration means by controlling said video output display through said position data;

receiving said control data from said host system configuration means by receiver means coupled to said cursor control means;

modulating said control data corresponding to said one selected mode to generate modulated control data through encoder means coupled to said receiver means;

transmitting said modulated control data representative of said one selected mode to said target device on transmitter means coupled to said encoder means.

9. A method according to claim 8, wherein the step of generating position data to said video output display through cursor control means comprises:

generating displacement signals representing the movement of said cursor control means relative to said position means on position means, said cursor control means emitting a continuous signal during the movement; and

generating said position data to said video output display responsive to said displacement signals on decoder means coupled to said cursor control means.

10. A method according to claim 8, wherein the step of generating a plurality of operating modes on said host computer comprises generating through a graphical user interface menu displayed on said video output display, one of said plurality of operating modes being selected by said position data.

11. A method according to claim 10, wherein the step of generating a plurality of operating modes on said host computer on host system configuration means comprises:

retrieving remote control functions stored in said memory of said host computer system through remote control means when selected as one of said plurality of operating modes and transferring said remote control. functions to said target device through said encoder means and said transmitter means;

updating said memory of said host computer system on learn control means with the control functions associated with a second target device not previously coupled to said system when selected as one of said plurality of operating modes, said control functions associated with said second target device being subsequently invoked by said remote control means;

activating said cursor control means through cursor mode means when selected as one of said plurality of operating modes.

12. A method according to claim 11, further comprising the step of:

retrieving network control functions store in said memory of said host computer system through network control means when selected as one of said plurality of operating modes and when said system is coupled to a third target computer through a network, said network con-

trol means transferring said network control functions to said target device through said encoder means and said transmitter means.

13. A method according to claim **12**, wherein said transmitter means transmits said modulated control data in infrared signal.

14. A method according to claim **9**, wherein said position means generates said displacement signals by reflecting said continuous signal from said cursor control means and said decoder means comprises an optical input for receiving the reflected continuous signal.

15. In a multimedia system having a host computer and a plurality of target devices supported by said host computer, wherein said host computer comprises of a central processing unit (CPU), memory, a graphical user interface (GUI)-based video output display, a control device for generating cursor control on said video output display and for operating said plurality of target devices, said control device comprising:

host system configuration means coupled to said CPU for generating a plurality of operating modes for each of said plurality of target devices on said GUI-based video output display, said host system configuration means generating control data for each of said plurality of operating modes capable of controlling said plurality of target devices by retrieving said control data from said memory;

control means coupled to said host system configuration means for selecting one of said plurality of operating modes for one of said plurality of target devices through said GUI-based video output display, said control means causing said host system configuration means to transmit said control data corresponding to one of said plurality of operating modes for one of said plurality of target devices;

receiver means coupled to said control means for receiving said control data from said host system configuration means;

modulator means coupled to said receiver means for modulating said control data with infrared signal;

transmitter means coupled to said modulating means for transmitting said infrared signal modulated with said control data to said one of said plurality of target devices;

optical interface means coupled to each of said plurality of target devices for receiving said infrared signal such that said control data operates said one of plurality of target devices when received by said target devices.

16. A control device according to claim **15**, wherein said host system configuration means further comprises update means for adding an additional target device to said plurality of target devices already supported by said host computer, said update means storing corresponding control data in said memory.

17. A control device according to claim **16**, wherein said control means comprises an optical cursor control and reflective pad for controlling cursor movement on said GUI-based video output display.

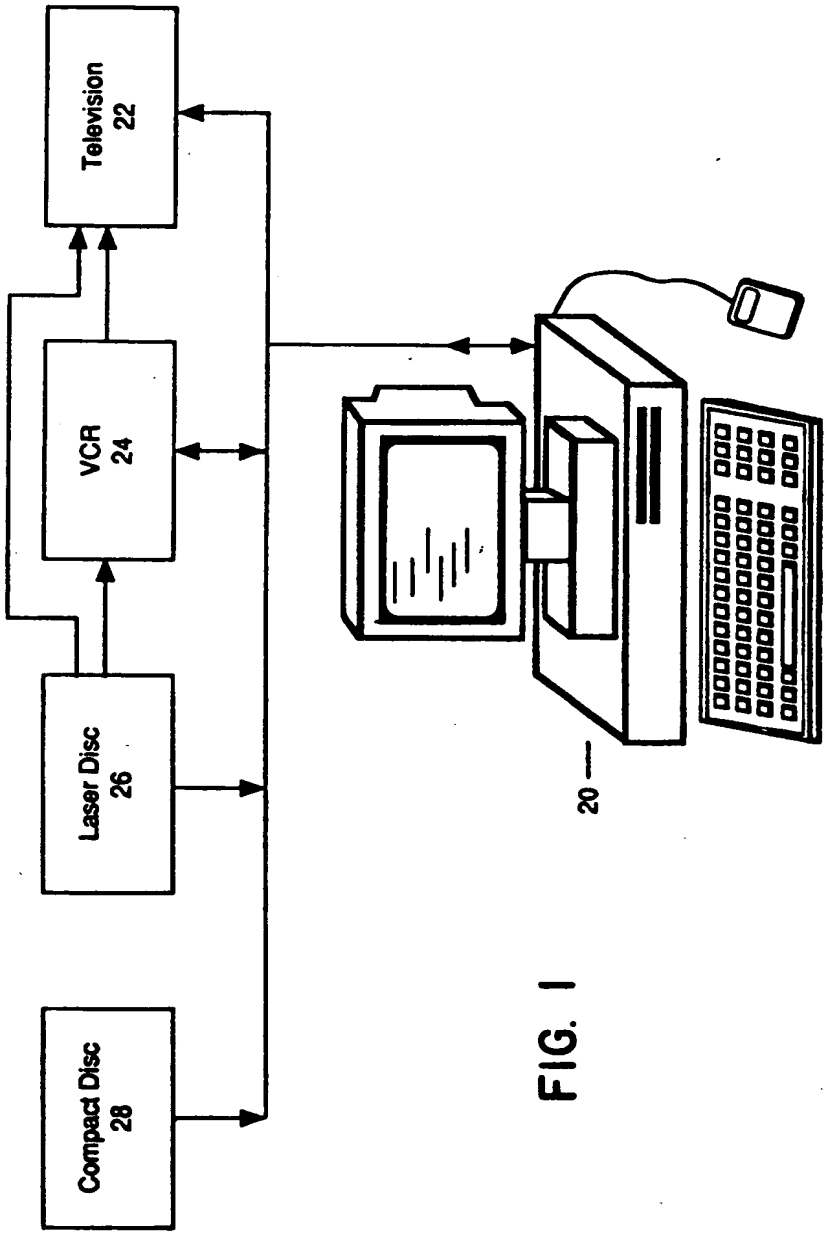


FIG. 1

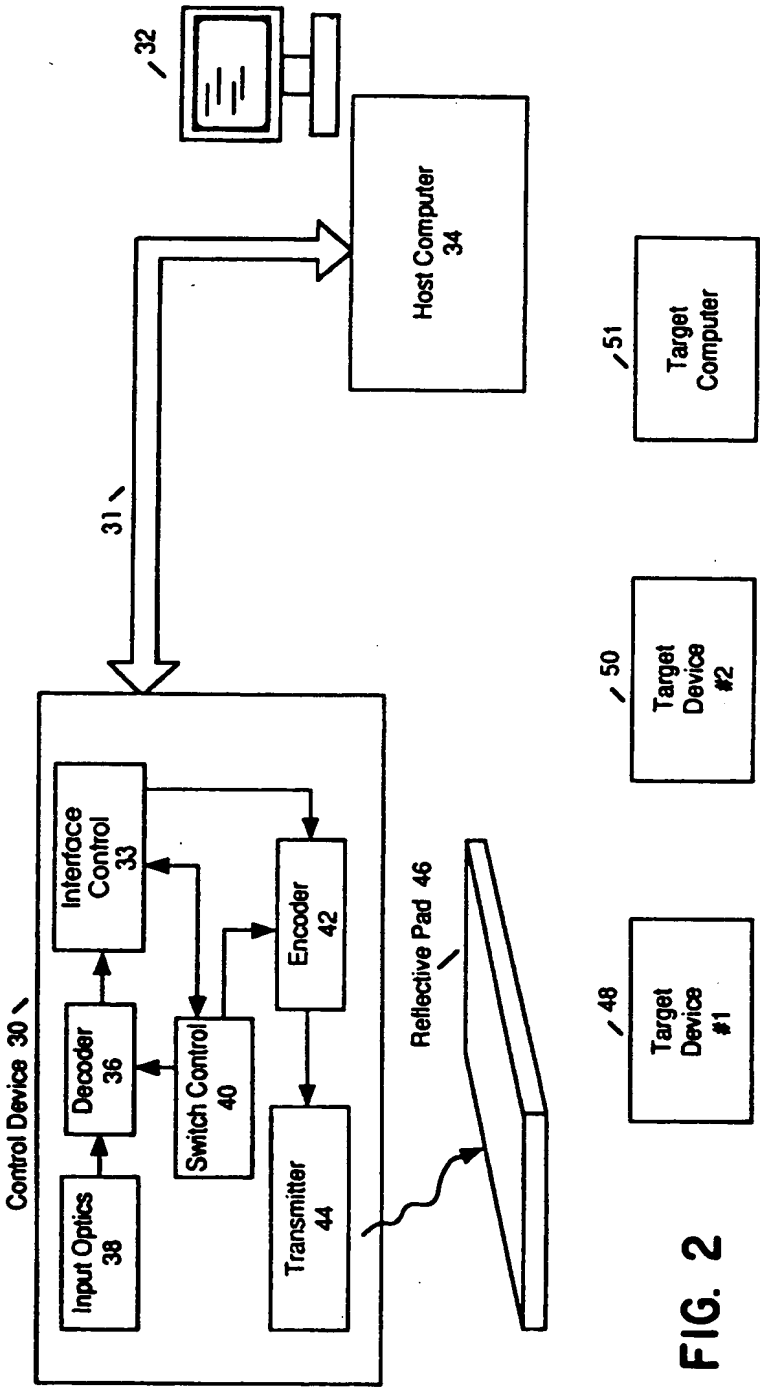

32
Host Computer
34
31
Target
Computer
51
Target
Device
#2
50
Target
Device
#1
48
Reflective Pad 46
Control Device 30
Interface
Control
33
Encoder
42
Decoder
36
Switch Control
40
Input Optics
38
Transmitter
44

FIG. 2

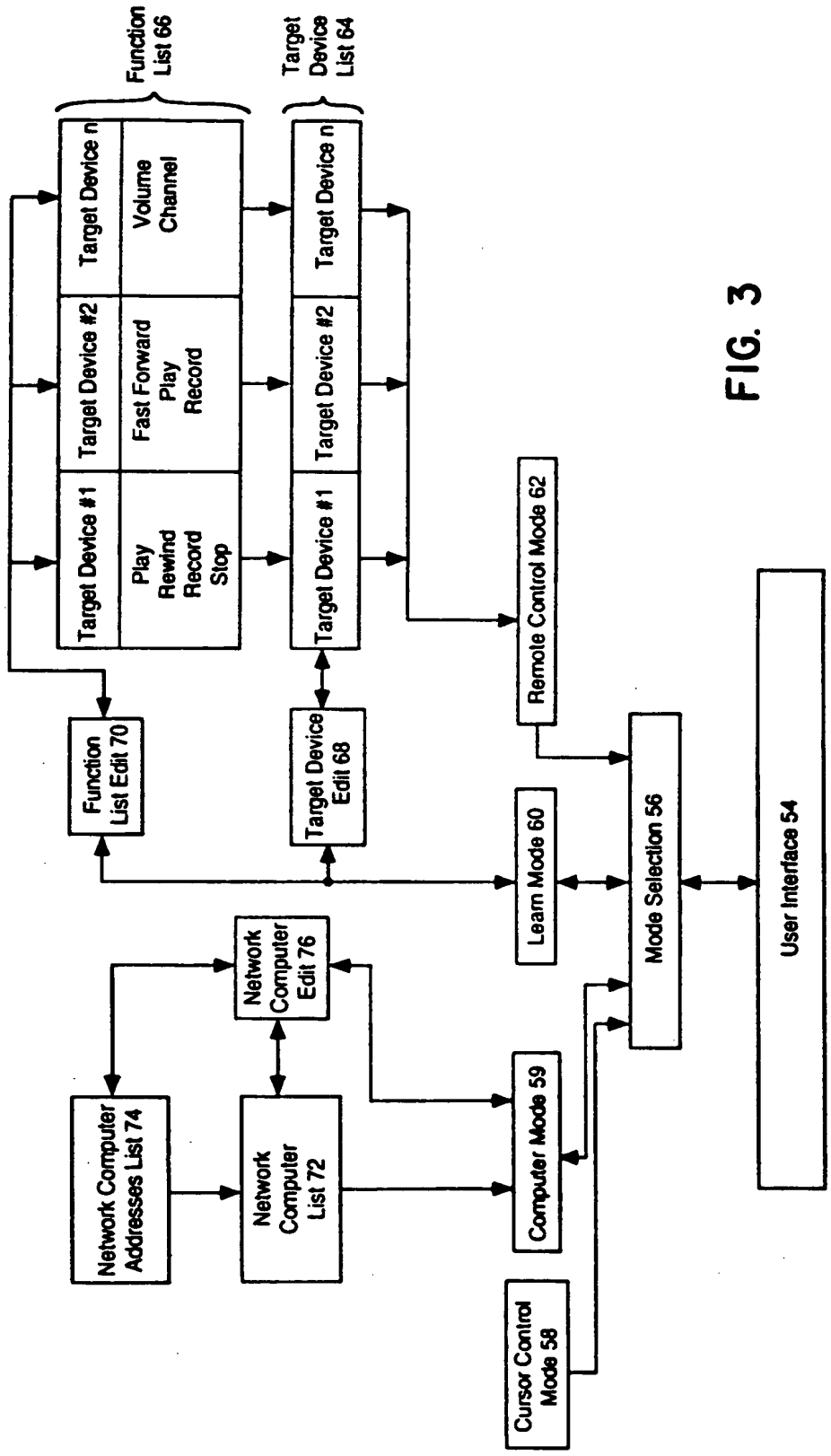

Function List 66
Target Device List 64
Target Device n
Volume Channel
Target Device #2
Fast Forward Play Record
Target Device #1
Play Rewind Record Stop
Function List Edit 70
Target Device Edit 68
Remote Control Mode 62
Learn Mode 60
Mode Selection 56
User Interface 54
Network Computer Edit 76
Network Computer Addresses List 74
Network Computer List 72
Computer Mode 59
Cursor Control Mode 58

FIG. 3

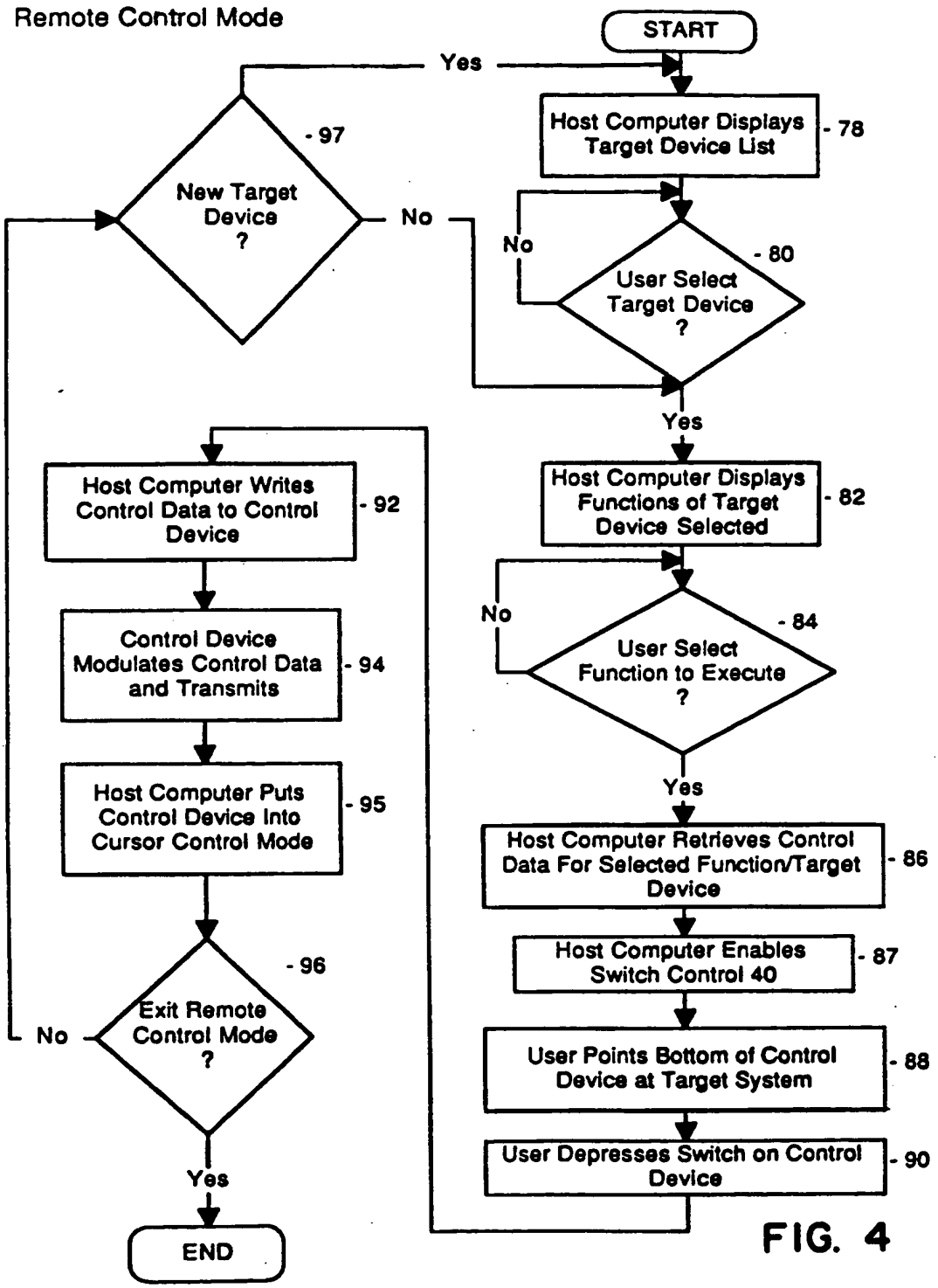

Remote Control Mode
START
Host Computer Displays Target Device List
78
User Select Target Device ?
80
No
Yes
New Target Device ?
97
Yes
No
Host Computer Displays Functions of Target Device Selected
82
User Select Function to Execute ?
84
No
Yes
Host Computer Retrieves Control Data For Selected Function/Target Device
86
Host Computer Enables Switch Control 40
87
User Points Bottom of Control Device at Target System
88
User Depresses Switch on Control Device
90
Host Computer Writes Control Data to Control Device
92
Control Device Modulates Control Data and Transmits
94
Host Computer Puts Control Device Into Cursor Control Mode
95
Exit Remote Control Mode ?
96
No
Yes
END

FIG. 4

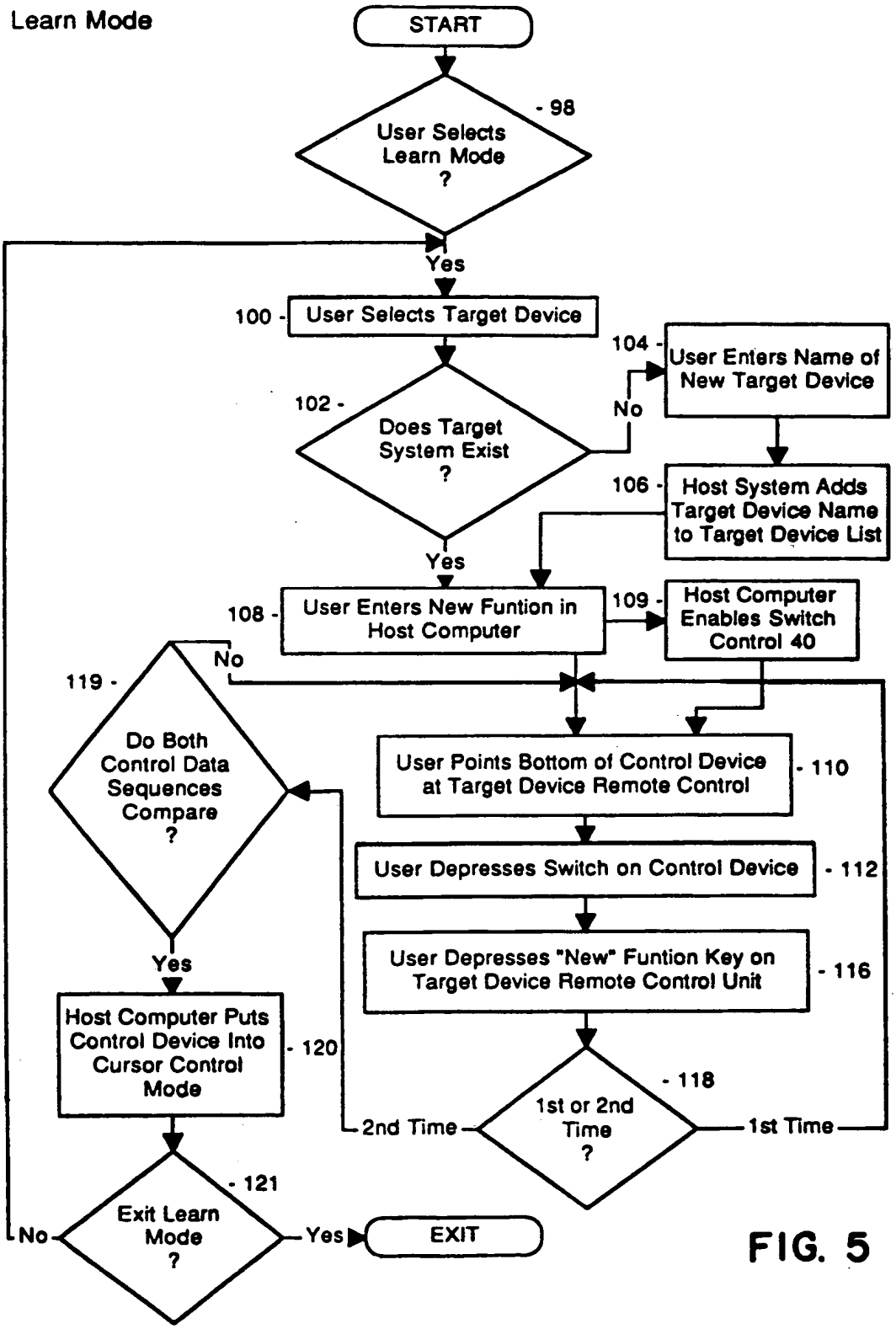
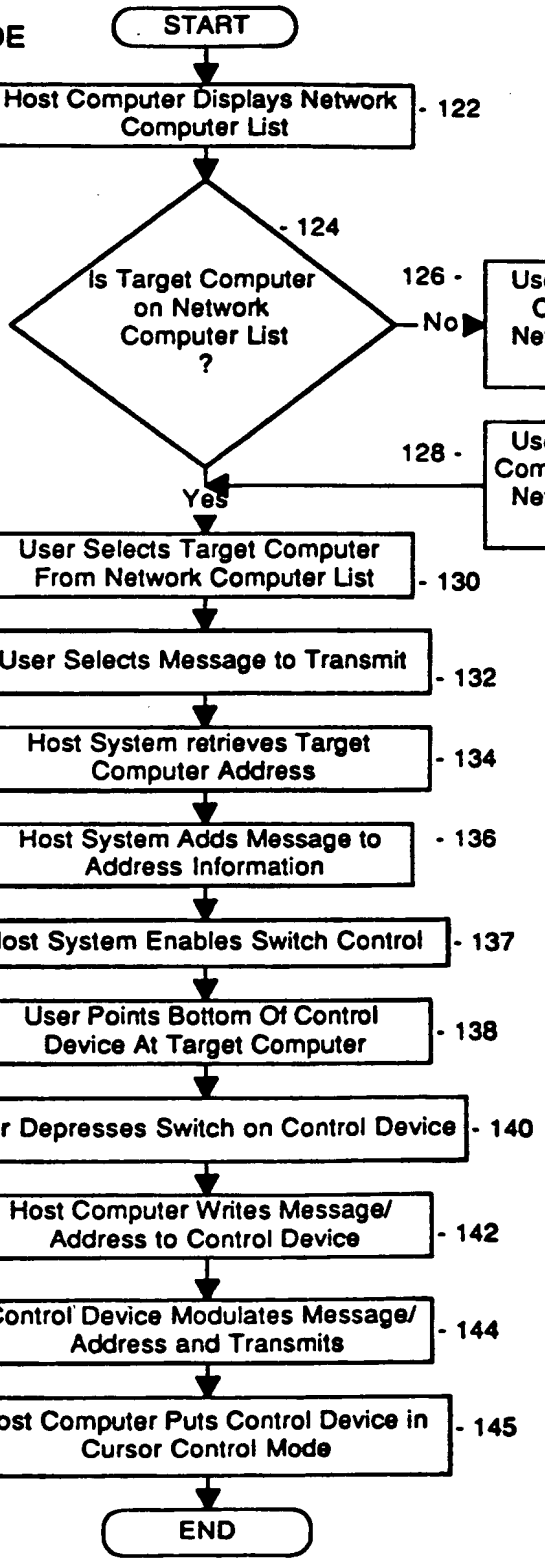

Learn Mode
START
User Selects Learn Mode ?
98
Yes
100
User Selects Target Device
102
Does Target System Exist ?
No
104
User Enters Name of New Target Device
106
Host System Adds Target Device Name to Target Device List
Yes
108
User Enters New Funtion in Host Computer
109
Host Computer Enables Switch Control 40
No
119
Do Both Control Data Sequences Compare ?
User Points Bottom of Control Device at Target Device Remote Control
110
User Depresses Switch on Control Device
112
User Depresses "New" Funtion Key on Target Device Remote Control Unit
116
Yes
Host Computer Puts Control Device Into Cursor Control Mode
120
118
1st or 2nd Time ?
2nd Time
1st Time
121
Exit Learn Mode ?
No
Yes
EXIT

FIG. 5

COMPUTER NETWORKING MODE

FIG. 6



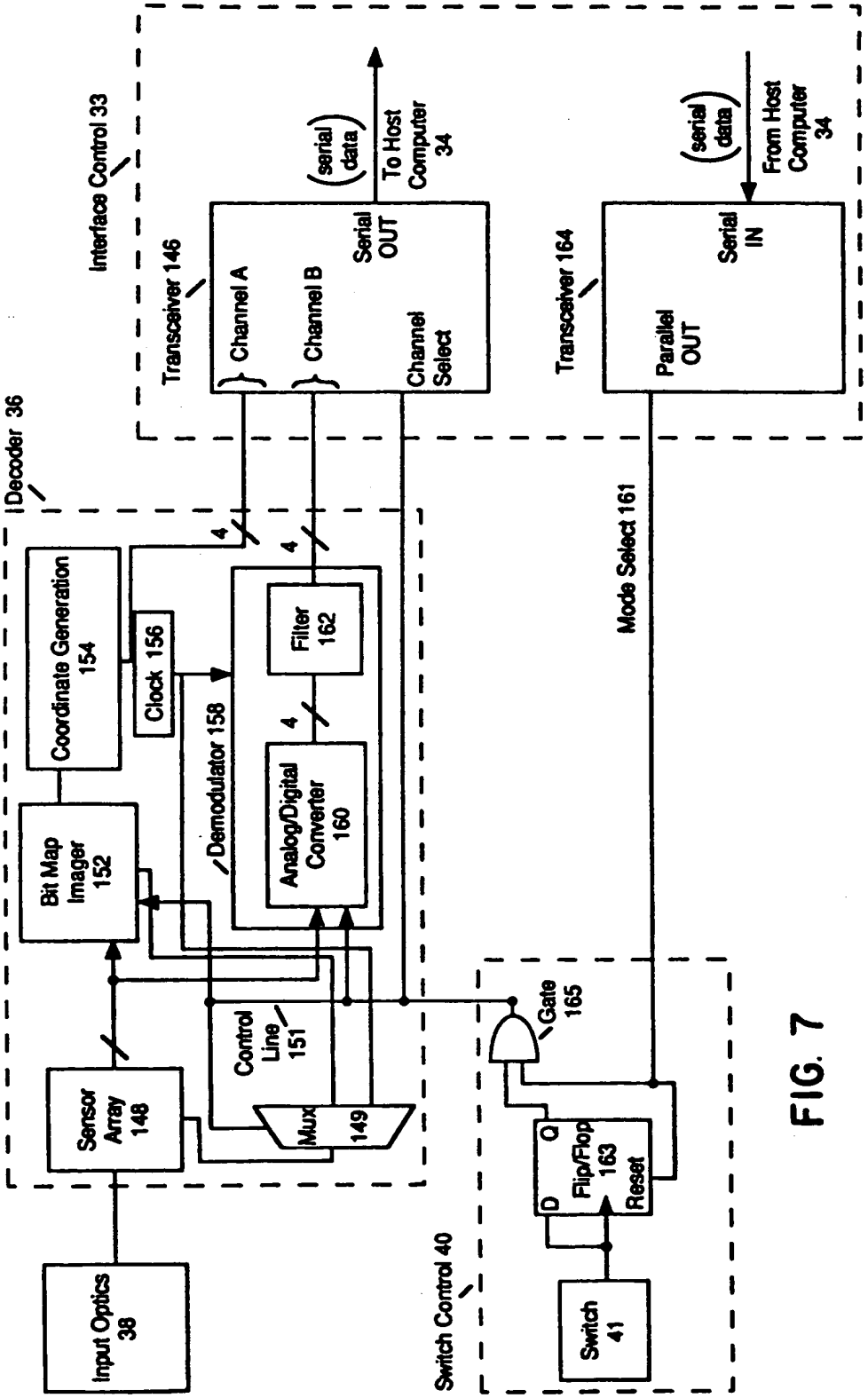

Interface Control 33
Transceiver 146
Channel A
Channel B
Channel Select
Serial OUT
(serial data)
To Host Computer 34
Transceiver 164
Parallel OUT
Serial IN
(serial data)
From Host Computer 34
Decoder 36
Mode Select 161
Coordinate Generation 154
Clock 156
Demodulator 158
Filter 162
Analog/Digital Converter 160
Bit Map Imager 152
Sensor Array 148
Control Line 151
Mux 149
Gate 165
D
Q
Flip/Flop 163
Reset
Switch Control 40
Switch 41
Input Optics 38
4
4
4

FIG. 7

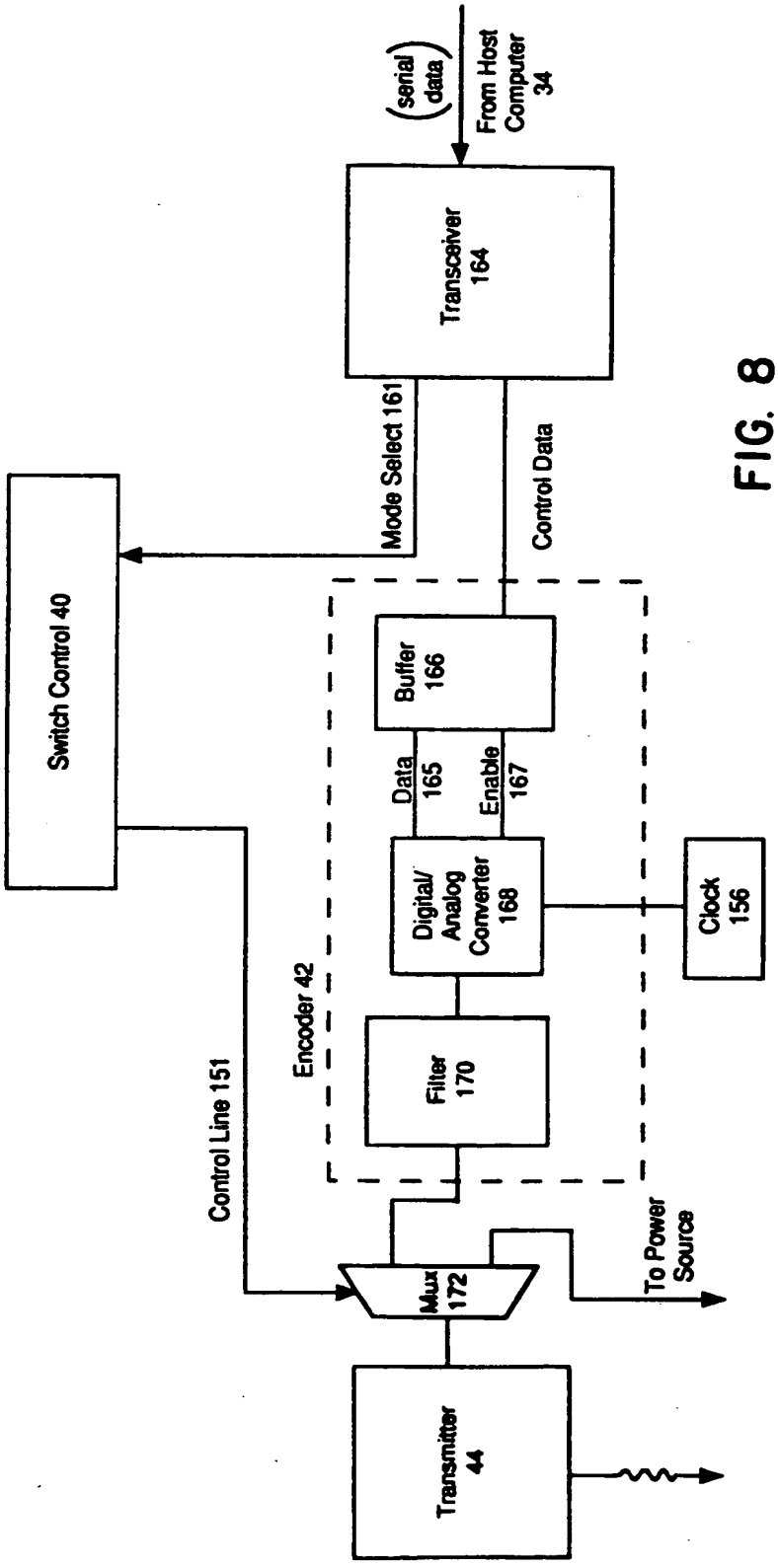

(serial data)
From Host Computer 34
Transceiver 164
Mode Select 161
Control Data
Switch Control 40
Buffer 166
Data 165
Enable 167
Digital/ Analog Converter 168
Clock 156
Encoder 42
Filter 170
Control Line 151
Mux 172
To Power Source
Transmitter 44

FIG. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 6255

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	EP-A-0 390 041 (MATSUSHITA ELECTRIC INDUSTRIAL CO) * column 2, line 39 - column 3, line 15 * * column 4, line 20 - column 7, line 32 *	1,3,8, 10,15	G06K11/18
Y	EP-A-0 354 313 (GRUNDIG E.M.V.) * the whole document *	1,3,8, 10,15	
A	EP-A-0 372 955 (MACKENZIE K. F.) * column 1, line 41 - column 2, line 31 * * column 7, line 26 - line 41 *	1,4,8, 11,15	
A	US-A-5 001 467 (CHIEN F. K. ET AL) * abstract * * column 2, line 21 - line 26 *	2,7,9,17	
A	US-A-4 623 887 (WELLES K. B.) * column 2, line 5 - line 39 * * abstract *	4,6,11, 13,16	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

G06K
G06F
H03J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 February 1994	Bailas, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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